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RESEARCH ARTICLE

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Usability test with non conventional goals – success and expenditure indicators

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Abstract

Technology alone may not win user acceptance and subsequent marketability. The user experience, or how the user experiences the end product, is the key to acceptance. And that is where user interface design enters the design process. While product engineers focus on the technology, usability specialists focus on the user interface. For greatest efficiency and cost effectiveness, this working relationship should be maintained from the start of a project to its rollout.

The customer wants to use the technologies by easier, faster and efficient ways, and the meeting point between the user and the service is the accessory products "user interface". The next study shows a potential way to select and test the better accessory devices to telecommunication services, with usability testing.

Keywords

usability testing · ergonomics · success rate · emotional effort

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1 The role and transformation of usability

Many of the products we use every day are partly digital: telephones, mobile telephones, audio systems, televisions, personal devise like MP3 players and personal digital assistants, and of course, computers manage our information and services. Their user interfaces are digital displays and we interact through digitally interpreted command gestures in different ways. These products support a huge variety of leisure or work activities. Interacting with these products entrains myriad personal experiences – efficiency and control, achievement and satisfaction, confusion and frustration, curiosity and wonder. Increasingly, they support and transform our social interactions and experiences – friendship, trust, admiration and suspicion. As these technologies become evermore ubiquitous in human lives, it is important to reflect on these experiences and understand better what the user needs.

The one of the most interesting threads of development in information science and technology through the past 25 years is in the fields evolving conception of "usability". The phenomenon of usability, and the theoretical and methodological construction of that phenomenon in practical design concepts and methods, is most centrally what the interdisciplinary field of Human-Computer Interaction (HCI) is all about. Yet meaning of the term "usability" has changed through the past two decades and likelihood will continue to change. Initially, usability was taken to be synonymous with "easy" or "simple". The defining challenge for HCI design in the 1980s was to produce concepts and methods to help ensure that computer software and hardware would be easy to learn and easy to use.

Today, technologically advanced means digital; people are immersed in digital information and digital devices. As understanding of people's experiences with information technologies developed and as the cultural baseline for these experiences became richer, the concept of usability was enriched with ideas from human development to include such notion as 'cognitively stimulating', 'consistent with prior knowledge', and 'transparently useful in the work at hand'.

During the 1990s, as collaboration became a major problem area for HCI, and as organizational issues became better un-

derstood, usability was further elaborated to incorporate notions like awareness of and access to other people in the performance of a work task, and support for existing workplace roles and practices [4, pp. 500–501].

2 Product usability and marketability

Technology alone may not win user acceptance and subsequent marketability. The user experience, or how the user experiences the end product, is the key to acceptance. And that is where user interface design enters the design process. While product engineers focus on the technology, usability specialists focus on the user interface. For greatest efficiency and cost effectiveness, this working relationship should be maintained from the start of a project to its rollout.

When applied to computer software, user interface design is also known as Human-Computer Interaction or HCI. While people often think of interface design in terms of computers, it also refers to many products where the user interacts with controls or displays. Optimized user interface design requires a systematic approach to the design process. But, to ensure optimum performance, usability testing is required. This empirical testing permits naive and experienced users to provide data about what does work as anticipated and what does not work. Only after the resulting repairs are made can a product be deemed to have a user optimized interface.

The importance of good user interface design can be the difference between product acceptance and rejection in the marketplace. If end-users feel it is not easy to learn, not easy to use, or too cumbersome, an otherwise excellent product could fail. Good user interface design can make a product easy to understand and use, which results in greater user acceptance.

3 Usability case study in the field of intelligent communication tools (ICT)

The good user interface is important in the services market too. The customer wants to use the technologies by easier, faster and efficient ways, and the meeting point between the user and the service is the accessory products "user interface". The next study shows a potential way to select and test the better accessory devices to telecommunication services, with usability testing.

The goal of usability tests was to find and identify the weaknesses of three different intelligent telecommunication tools: a DECT telephone (product A), a video-telephone (product B) and a "home-box" (product C). The three tools were dedicated to the market expletively telecommunication services.

3.1 User Profile

Before the usability tests the user profile was defined by the ergonomics professionals' team. The three products are general ICT products, that's why 50% of the 70 test persons were male and the other 50% was female. In the first – focus group testing – part attended 42 persons, 12-15 persons each of the three products' group.

By the age participants composed four categories. In the first category (age 18–24) was 70% of the test persons, because the products were dedicated to this target audience. 16% were of the test persons belonged to the next (age 25–35) category and 10 % to the third (age 35–44) category. To the fourth age group (older than 55) belongs 3% of test persons.

By the preliminary user experience, except 5%, the test persons used mobile telephone, telephone and computer. 60% of participants tried to use tools with touch screen and DECT telephone.

3.2 Ergonomic requirements of Intelligent Communication Tools (with professional and user focus groups)

The usability test method had two different parts. During the firs part two different focus groups were the tester, and the first question was that what the main general 15-20 ergonomic requirements are, and in the next focus group (user group) tested it.

3.2.1 Professional focus group – general requirements

The examined services were telecommunication, and the accessory devices were the group of the Intelligent Communication Tools in this area. The main representative products: mobile phone, fax, video-telephone, PDA, home box, DECT telephone, pager, and navigation set.

The general ergonomic "quality" of these products was determined by 3 main ergonomic basic-requirement groups: safety, efficiency and comfort. Safety means the usage without accident, and human trauma or product damage. Efficiency is the rate, the product can accomplish its goals with. Comfort is the degree of the product meets user needs and generates positive or negative feelings.

The potential and general ergonomic requirements on this type of products were collected by a professional focus group. The requirements concerning safety, efficiency and comfort, and the members of the focus group were weighted individually it, in a 5 degree scale. The definition of the scale-grades (anchoring-points) was the following:

1 The user is not interested in this product attribute – "not bad if the product able to. . . "

2 The user minimal level expect it – "it is good, but not important. . . "

3 The user need this product attribute – "shortcoming, but the lack of this attribute can be tolerated"

4 Important to the user – "if it is not available, the user is disaffected"

5 Essential product attribute – "if the product can not perform, then it is not right designed".

Tab. 1. General requirements

Number	Ergonomic Requirement	Priority
13	The design of the devices menu must be simple, and the menu must be adequate to the cognitiv capability of the user.	**4.7**
5	The formal and functional design must minimize the risk of the user or the device to be injured.	**4.6**
10	The transmitted information must be audible and visible in high quality, without reference to environmental circumstances.	**4.3**
15	The menu and the navigation function must be coherent.	**4.3**
17	Directions for use must contain reasonably, informative and full particulars from usage.	**4.3**
6	The period of the usage the user gets all the necessary feedback.	**4.1**
20	Must be deep connection with Navigation facilities and user interface.	**4.1**
7	The user interface accommodates to the users anthropometrical and biomechanical parameters.	**3.9**
3	To reach the wanted function must be easy and obvious.	**3.7**
18	The symbols on the user interface must be univocal, standardized, conventional and different from each other.	**3.7**
1	The formal design of the device gives comfortable grip and hold to the user.	**3.6**
4	The formal and functional design ensured to avoid the unintended actions.	**3.3**
12	Using method suggests experience of similar products.	**3.3**
19	Reaction times of the user and device accommodate to each other.	**3.1**
14	Information in the memory of device must be available from every required menu point.	**3.0**
2	Installation and commission must be simple and univocal.	**2.7**
8	Product design and the style of the user interface must be enduring.	**2.6**
9	Device must be easy to clean.	**2.1**
16	The formal design obviously suggests the method of use.	**2.0**
11	Device can be personalized by the user.	**1.6**

The results of general requirements

3.2.2 User focus group – product specific requirements and importance-user satisfaction diagram

The general requirements were adapted to the 3 products (A,B,C) and the tests of users focus groups were based on these "product specific" requirements. The testing method was:

1 The members of focus group (12-15 representative user) get acquainted with the product by some special exercises and individually proving.

2 They check and define the product specific requirements with help of moderator person.

3 The product is evaluated individually from the importance of product specific requirements point of view by the members of focus group. The scale points are the same as the professional focus groups points (1–5).

4 The product is evaluated individually from the user-satisfaction point of view by the members of focus group. The scale points are 1–5 (1 means "Not important", 5 means "High importance").

Importance–User satisfaction diagram is arisen from the means of the user focus group individually evaluation. The ergonomic "quality" of the product can be quantified with this method.

The points in the left bottom part of the diagram mean that requirements what had been stand for low importance to the users and they were not satisfied with it. The points in the right top quarter of the diagram present the high satisfaction with high importance requirements. Points that located in these two parts are in the right place. In the left top quarter located point presents the "must develop" product attributes. And in the right bottom quarter located points presents the "promote" product attributes.

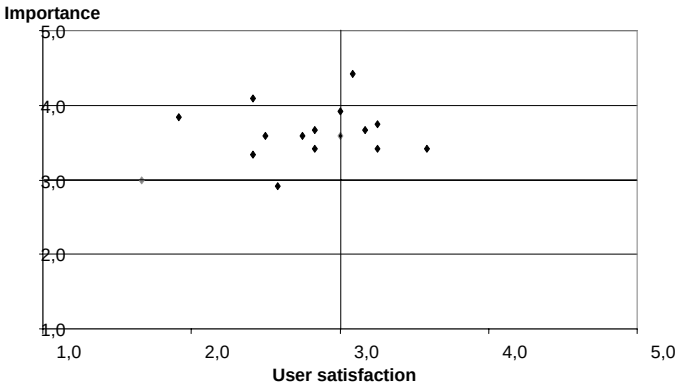

Fig. 1. For example: importance–user satisfaction diagram (Product C)

3.2.3 The usability test method

First of all participants signed release forms and nondisclosure agreements and a *pre-test questionnaire* was filled in. A questionnaire helped us understand the users conceptual models of the product, and the users experiences with similar products.

Usability tasks were what the participants had done in real life. (Installation, switch on/of, navigation, save information, calls, etc...) Through careful observation and limited interaction with the participant, we could see how well the product meets each customer's needs. During the course of a usability test, the test users are asked to verbalize their thoughts, feelings, and opinions while interacting with the system. It is very useful in capturing a wide range of cognitive activities. Two variations of thinking-aloud protocol technique are [6, p. 195]:

Critical response: this requires the user to be vocal only during the execution of certain predetermined subtasks.

Periodic report: this is used when the task is complex and

Tab. 2. Successibility indicators product A (for example)

Person Task	BD1	BD2	BD3	BD4	B_{mean}	ED1	ED2	ED3	ED4	E_{mean}
D1	1	1	1	0	**0.75**	3	1	3	3	**2.50**
D2	3	3	3	3	**3.00**	3	3	3	3	**3.00**
D3	3	3	3	0	**2.25**	3	3	3	3	**3.00**
D4	3	3	3	1	**2.50**	1	1	3	1	**1.50**
D5	-	-	-	-	**-**	1	3	3	1	**2.00**
D6	3	3	3	0	**3.00**	2	1	3	3	**2.25**
D7	-	-	-	-	**-**	2	3	3	3	**2.75**
D8	-	-	-	-	**-**	3	3	3	1	**2.50**
D9	3	3	3	0	**3.00**	-	-	-	-	**-**
D10	3	3	3	0	**3.00**	3	1	3	1	**2.00**
D11	-	-	-	-	**-**	2	1	3	1	**1.75**
D12	3	3	3	0	**3.00**	3	3	3	3	**3.00**
D13	3	3	0	3	**3.00**	-	-	-	-	**-**
D14	1	3	1	1	**2.00**	3	3	3	1	**2.50**
Individual Success Indicator	**2.6**	**2.8**	**2.3**	**0.8**		**2.4**	**2.2**	**3.0**	**2.0**	
Group indicator: SAB_f 2.55 SAE_f 2.40										
Product success rate: SA_f 2.47										

makes it difficult for users to think aloud while performing the task at the same time. The user, therefore, verbalizes at predetermined intervals of time and describes what he/she is currently trying to achieve. The length of the interval depends upon the complexity of the task. This technique is very time consuming, so it is recommended for subdivisions of a task. The periodic report was taken in our test.

After the test tasks, participants answered questions about each aspect of the product. Comparison with responses from the pre-test questions can show whether the product matched the user's conceptual model of the task.

3.3 The evaluation of the research methods

This part is the interpretation of the experimental data and resulting indicators of the usability study

3.3.1 Successibility

The successibility is the feature of effectiveness of finding solutions for tasks while using the product. During the project oriented usability studies the success rate of well characterized tasks defined in the product-specific booklets were evaluated on a 4 grade scale (0–3).

The definition of the scale-grades (anchoring-points) were the following:

Success scale:

0 = Did not solve the problem. He/She started to work on it but gave it up in some time.

1 = Solved the problem with the use of greater help (with the help of the manual or a guide(moderator).

2 = Solved the problem with little use of help, meaning codepage (menu-map, keyboard layout, the diagram of the machine parts). He/She did not use any other help.

3 = Solved the problem without any help.

We defined the average success rate indicator of the groups of 4 persons of investigation from the scale values based on each tasks as a beginner B an expert E (B_{mean}; E_{mean}), and for every single person the success rate for 1 task considering all the tasks indicated in the manual. We calculated the relative success rate of the two subgroups (B and L) (SXB_f, SXE_f – where X stands for the code of the given product (A, B, C) and then the mean quantity of the two group-characteristics (SX_f), that shows the user success rate of the given product.

To sum it up, we generated a usability value (SX_f) from the data in the table for task, persons examined, groups of users and products.

3.3.2 Expenditure

Besides the success of the usage of the product another important feature of the usability is what kind of expenditures was necessary to solve the problems („cost" from the aspect of time or psychology).

Time aspect One of the expenditure values is the time spent on solving given problems per person (in seconds). We calculated average data from this – according to, what has been described in the success rate value – per person and per groups. Besides we calculated the time spent on using the product based on sub-groups (B and L), and defined a value of the time spent on the usage of a given product (TX_f).

The emotional reactions brought up by using the product During the problem solving phase, the certain operations bring about such emotional reactions in the users that can be easily recognized, elucidated and measured on a scale by an expert observer. The emotional reactions during the studies are usually verbal as well that is validated by the metacommunicative act that is recorded on video tape. This way we are able to verify later, whether the registering person did the coding properly on the site.

Emotional effort scale (−1 – 0 – 1 – 3) anchoring points:

−1 = Success experience: the problem solving generates a positive experience in the person studied (the (-) sign shows that the emotion could not be considered to be „expenditure" rather than compensation of the negative emotions).

0 = Indifferent: solving the problem did not trigger any emotional reaction from the person studied.

1 = Fret oneself: solving the problem triggered negative emotion or slight frustration.

3 = Burst of anger: big frustration, aggressive reactions were triggered or inhibited that resuls in total block.

Tab. 3. Expenditure of Time (Product A)

Person Task	BD1	BD2	BD3	BD4[1]	B_{mean}	ED1	ED2	ED3	ED4	E_{mean}
D1	146	209	136	1371	**465.5**	59	157	35	104	**88.8**
D2	21	21	26	143	**52.8**	28	36	33	21	**29.5**
D3	30	27	53	1614	**431.0**	29	28	26	26	**27.3**
D4	111	84	70	1342	**401.8**	83	82	109	225	**124.8**
D5	-	-	-	-	**-**	69	472	763	164	**367.0**
D6	25	20	57	0	**34.0**	28	18	24	7	**19.3**
D7	-	-	-	-	**-**	53	43	68	45	**52.3**
D8	-	-	-	-	**-**	37	186	130	176	**132.3**
D9	40	41	58	0	**46.3**	-	-	-	-	**-**
D10	25	63	117	0	**68.3**	50	316	54	67	**121.8**
D11	-	-	-	-	**-**	28	126	53	180	**96.8**
D12	154	49	73	0	**92.0**	97	110	38	65	**77.5**
D13	40	46	453	55	**148.5**	-	-	-	-	**-**
D14	247	13	137	480	**219.3**	124	30	11	115	**70.0**
Individual Time result	**83.90**	**57.30**	**118.0**	**500.5**		**57.08**	**133.67**	**112.0**	**99.58**	
Group result: TDB_f	**195.94**	**TDE_f**	**100.58**							
Product result: TA_f	**148.26**									

Tab. 4. Emotional effort (product A)

Person Task	BD1	BD2	BD3	BD4	B_{mean}	ED1	ED2	ED3	ED4	E_{mean}
D1	1	1	1	1	**1.00**	-1	0	-1	0	**-0.5**
D2	0	-1	0	-1	**-0.50**	-1	-1	-1	-1	**-1.0**
D3	-1	-1	-1	3	**0**	-1	-1	-1	-1	**-1.0**
D4	-1	0	0	3	**0.50**	0	1	1	0	**0.5**
D5	-	-	-	-	**-**	0	0	1	0	**0.33**
D6	-1	-1	0	-	**-0.67**	-1	1	-1	-1	**-0.5**
D7	-	-	-	-	**-**	0	0	0	-1	**-0.25**
D8	-	-	-	-	**-**	-1	0	1	0	**0.0**
D9	-1	0	-1	-	**-0.67**	-	-	-	-	**-**
D10	-1	0	0	-	**-0.33**	-1	1	0	-1	**-0.25**
D11	-	-	-	-	**-**	-1	0	0	0	**-0.25**
D12	0	0	-1	-	**-0.33**	-1	-1	0	-1	**-0.75**
D13	1	1	1	-1	**0.50**	-	-	-	-	**-**
D14	1	-1	1	1	**0.50**	1	0	-1	0	**0.0**
Individual Emotional expenditure	**-0.2**	**-0.2**	**0**	**1.0**		**-0.58**	**0.0**	**-0.17**	**-0.5**	
Group result: EDB_f	**0.0**	**EDE_f**	**-0.2**							
Product result: SA_f	**-0.1**									

Individually and task rates can be calculated from this type of data with contraction. We calculated the emotional reaction indicator of the two subgroups (B and L).

3.3.3 Comparative evaluating of the A B and C product indicators

Different products can be comparable with these types of indicators. Similar type of usability test and evaluation are very useful in decision-making process, when the goal is to choose an accessory tool and we have 2-5 opportunities.

4 Conclusion

Usability testing is a black-box testing technique. The aim is to observe people using the product to discover errors and areas of improvement. Usability testing generally involves measuring how well test subjects respond in four areas: efficiency, accuracy, recall, and emotional response. In this case study, the successibility, time, and emotional reactions were the main measured or estimated indicators. With these indicators we were able to compare the products and we had quantified data to describe the product and the user interface.

Tab. 5. Comparative evaluating of the A B and C product indicators (Successibility, Time, Emotional effort and cumulative indicators). The results show that product B is the worst designed product from the usability aspect, because the effectiveness rate is the lowest. In the sub-group of the Experts product C needs the most of the emotional efforts but in the sub-group of the Beginners product B was that. Successibility rate was the lowest in the beginners sub-group with product B.

Successibility

B/L: Product:	Beginners (SXB_f)	Experts (SXE_f)
Product A	2.55	2.40
Product B	1.58	2.33
Product C	2.25	2.53

Expenditure of time

B/L: Product:	Beginners (TXB_f)	Experts (TXE_f)
Product A	196	101
Product B	181	100
Product C	149	119

The emotional reactions brought up by using the product

B/L: Product:	Beginners (EXB_f)	Experts (EXE_f)
Product A	0.0	-0.2
Product B	+0.83	+0.54
Product C	+0.70	+0.70

Compare product attributes

B/L: Product:	Successibility (SX_f)	Time (TX_f)	Emotional expenditure (EX_f)	Effectiveness $(SX_f)/(TX_f)\times 100$
Product A	2.47	148	-0.1	1.67
Product B	1.96	140	+0.69	1.40
Product C	2.40	134	+0.69	1.79

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